Project Risk Management – Process

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FNAL-BARC Meeting

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Outline

- Risk Management - Definition
- Steps in the Risk Management Process
  - Ranking of Risks – LBNF/DUNE Methodology
  - Risk Mitigations and Response Plans
- FNAL Risk Management Process
  - LBNF/DUNE Risk Register – Example Entry
- Summary and next steps

Risk Management

- Risk management is the practice of identifying, evaluating, and preventing or mitigating risks to a project that have the potential to impact the desired outcomes (performance, cost, schedule)

  “Risk management is really about looking at your project objectives and figuring out what the threats to those objectives are, and what you can do to address them from the beginning.”

  “Project risk is a future event that may or may not happen which, if it does happen, will have some impact on the objectives of the project. It could be positive—an opportunity, or negative—a threat.”

  Connie Emerson, Professor, Northeastern University Project Management program.

- Project managers (or equivalent) are usually responsible for overseeing the risk management process throughout the duration of a project.

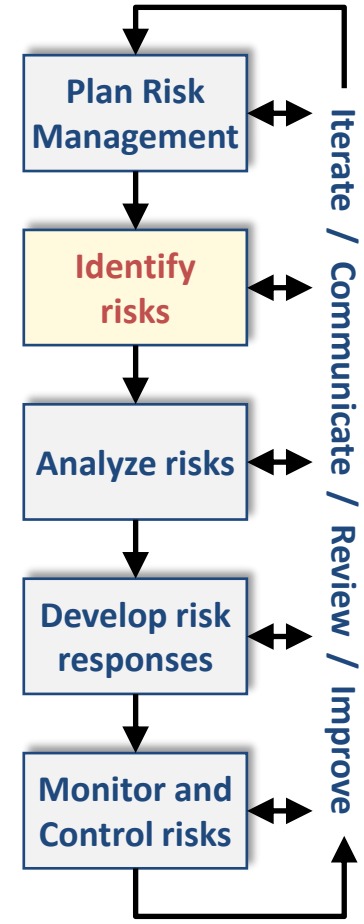
  - To effectively manage risk, project managers must have a clear understanding of their objectives so they can identify any possible barriers that could impact the team’s ability to produce results.

  - To protect a project from unplanned risk, project managers typically follow an ongoing risk management process which helps them identify, understand, and respond to threats and opportunities.

- Helpful link for more info on Risk Management: https://www.northeastern.edu/graduate/blog/project-risk-management/

Steps in the Risk Management Process

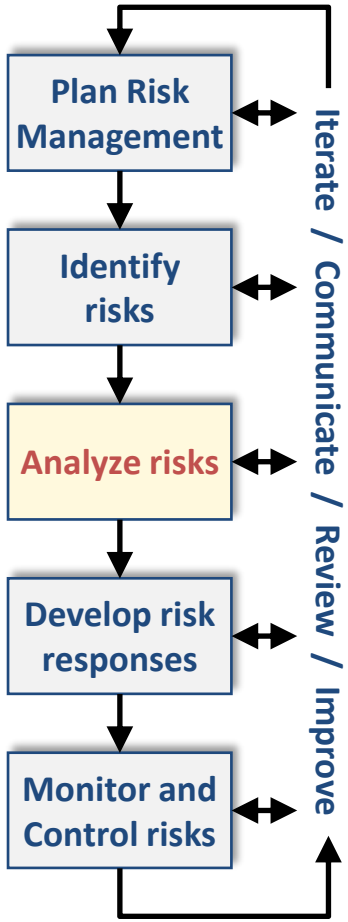
1. **Develop a risk management plan**
   - Could be a risk management tool or can be done manually
2. **Identify the Risks** (that could potentially impact the project)
   - There could be many different types of risks – resource, technical/technology, design, vendor, manufacturing, assembly, market, regulatory, etc.
   - Assess project for all possible risk elements that could affect performance, cost and schedule. Assign ownership of each identified risk to a team member.
3. **Analyze the Risks**
   - Determine scope of risk and its impact to project activities
   - Determine probability of the risk happening, and the cost and schedule impacts
4. **Develop Risk Responses**
   - Rank the risks and determine risk mitigations and response plans (see next 2 slides)
5. **Monitor and Control Risks**
   - Actively evaluate and update risks, conduct focused risk workshops, *be proactive instead of reactive.*



LBNF/DUNE Ranks risks by probability and impacts

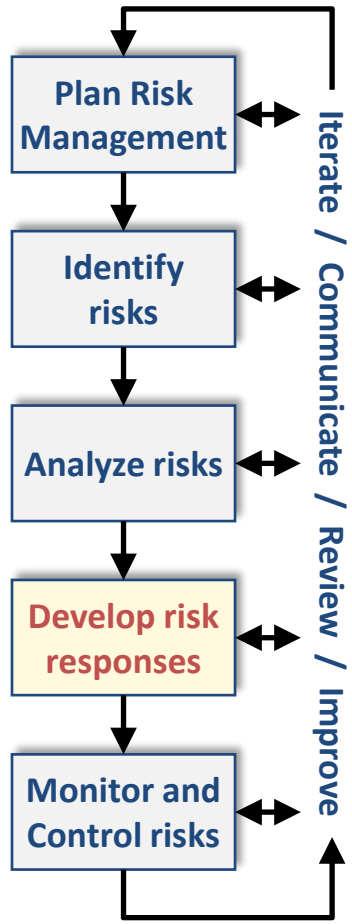
Risk Impacts

Risk Probability			Low	Medium	High
		Technical	Slightly sub-standard	Moderately sub-standard	Very sub-standard or KPP in jeopardy
		Cost	(0.1 - 1) M$	(1 - 10) M$	> 10 M$
		Schedule	< 6 Months	(6-12) Months	> 12 Months
	V. High	64 - 100%			High Rank
	High	39 - 64%		Medium Rank	30 LBNF/DUNE Risks in total
	Medium	21 - 39%	Low Rank	114 LBNF/DUNE Risks in total	
	Low	9 - 21%	122 LBNF/DUNE Risks in total		
	V. Low	0 - 9%			

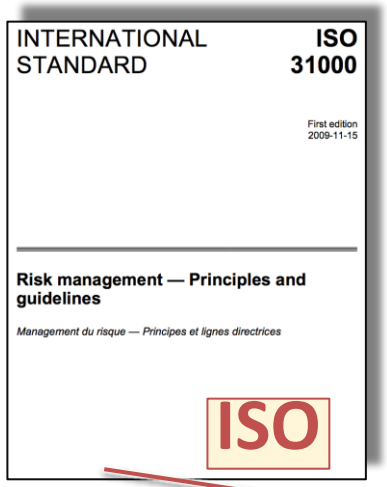


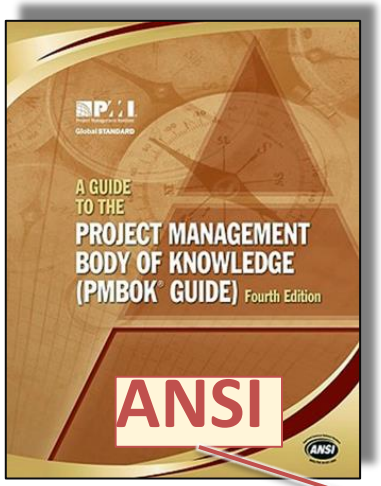
Risk mitigations and response plans

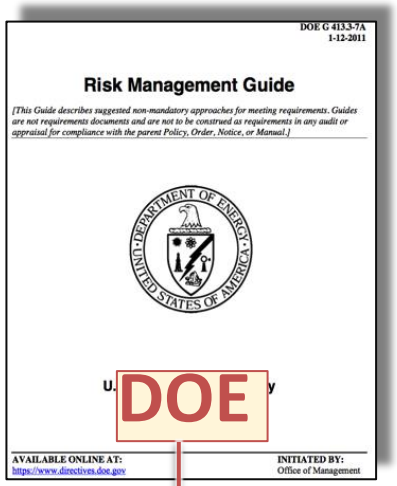
- **Risk mitigations** – pre-emptive actions to reduce risk probability and/or impacts
  - Mitigation activities are incorporated in the project plan along with associated costs and durations
- **Risk response plans** – actions taken only if a risk occurs, to reduce the impacts
  - Not part of the baseline plan
  - Costs and delays covered by risk contingency
- Plans are developed by SMEs and management and are summarized in the risk register
  - More details can be stored in DocDB documents

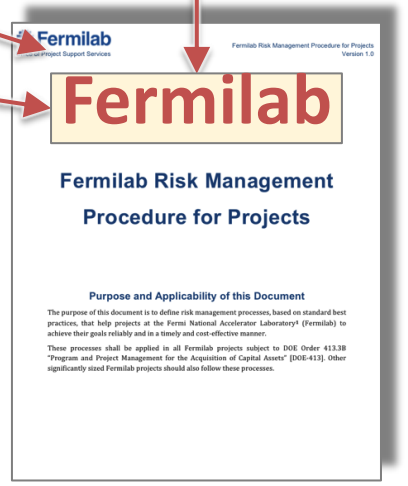


Risk Management Process

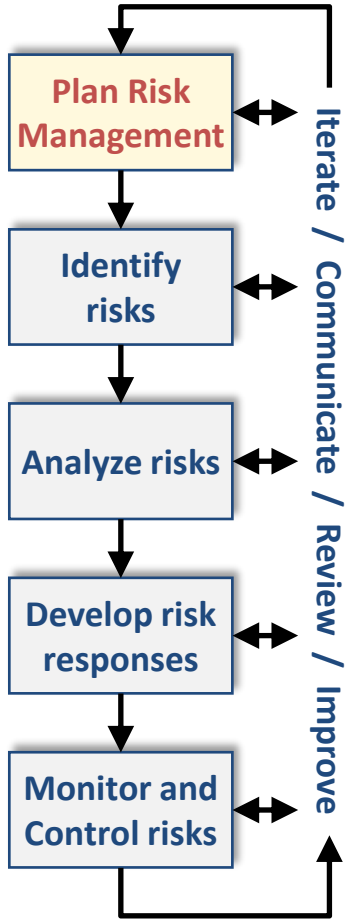






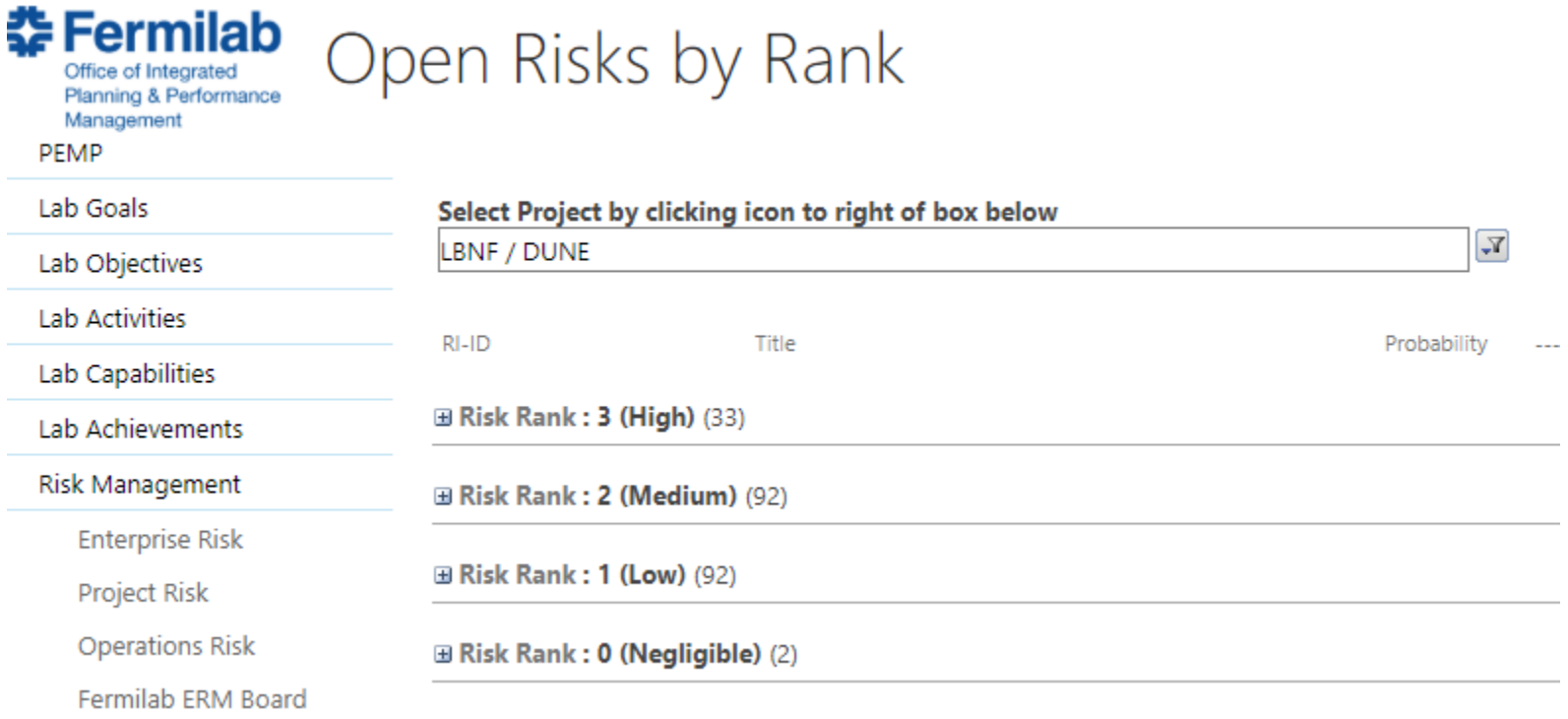


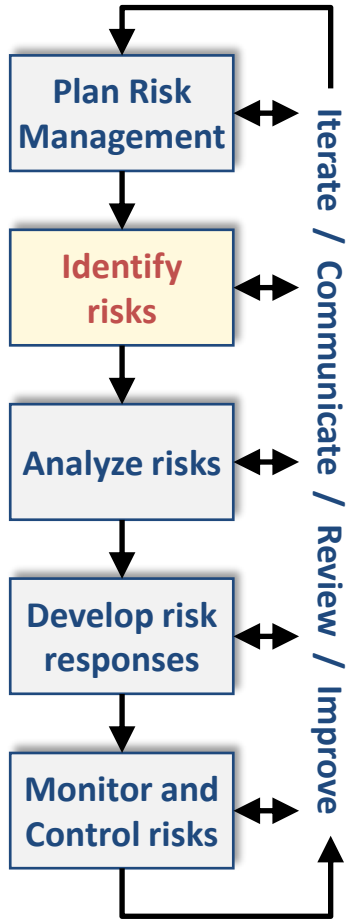
Fermilab has standardized their [Risk Management Procedure for Projects] – this constitutes the LBNF/DUNE "Risk Management Plan"



LBNF/DUNE Risk Register

- Fermilab-standard tool – risk DB with web interface
  - Multi-user, various views of data, filters, data export
  - Manages data, risk status, approvals, risk ownership
- Link to LBNF/DUNE Risk Register





Example Risk Entry – LBNF/DUNE Risk Register

RI-ID	RT-131-BEAM-161 Unique risk identifier (leave blank if unsure)
Title *	Late Delivery of Dipole and/or Quadrupole Magnets Concise name of risk event
Project *	LBNF / DUNE Select your project or "operations area".
Summary	If magnet delivery is delayed, then completion of PB installation will be delayed. Example: If <RISK> occurs then <IMPACT> jeopardizes <OBJECTIVE>
Risk Type	Threat Opportunity has +ve impact. Threat has -ve impact. Uncertainty has either +ve or -ve impact (e.g. exchange rates).
Risk Area (RBS)	External Risk / Collaborators
Owner	Gueorgui Velev x Person most responsible for dealing with the risk
WBS / Ops Lab Activity	131.01.03.03 - Beamline
Risk Status	Open Status of the risk itself
Approval Status	4 - approved Status and actions in the risk review process

Example Risk Entry – LBNF/DUNE Risk Register Contd.

RISK PROBABILITY AND TECHNICAL IMPACT

Start Date	
	Approx. date when risk might first occur or when some action is needed
Expiration Date	
	Approximate date after which risk should not occur
Conditions for closing risk	Delivery of Quadrupole and Dipole magnets from BARC.
	Describe conditions under which this risk can be retired or closed
Probability	25 %
	Estimated risk probability (%). If you have a range enter the mid-point.
Technical Impact	0 (N) - negligible technical impact
	Technical impact after risk mitigations and risk responses are done.

Example Risk Entry – LBNF/DUNE Risk Register Contd.

COST IMPACTS (+ve for overruns, -ve for savings)
Including costs of risk event AND associated response plans.
Do not include mitigation costs -- these are in the baseline plan.

Impact (k$) - Function	1-point - single value 1-point - single value --> specify most likely impact only 2-point - flat range --> specify min / max impacts only 3-point - triangular --> specify min / most likely / max impacts
Impact (k$) - Min	Min. cost impact (k$) for 2- / 3-point estimates (not needed for 1-point)
Impact (k$)	0 Most likely cost impact (k$) for 1- / 3-point estimates (not needed for 2-point)
Impact (k$) - Max	Max. cost impact (k$) for 2- / 3-point estimates (not needed for 1-point)

Example Risk Entry – LBNF/DUNE Risk Register Contd.

SCHEDULE IMPACTS (+ve for delays, -ve for schedule advances)
The schedule impact (delay) to the immediate successor activities.

Impact (months) - Function	3-point - triangular
	1-point - single value --> specify most likely impact only 2-point - flat range --> specify min / max impacts only 3-point - triangular --> specify min / most likely / max impacts
Impact (months) - Min	3
	Min. impact (months) for 2- / 3-point estimates (not needed for 1-point)
Impact (months)	6
	Most likely schedule impact (months) for 1- / 3-point estimates (not needed for 2-point)
Impact (months) - Max	9
	Max. impact (months) for 2- / 3-point estimates (not needed for 1-point)
Impacted Activities	
	Activities that are directly impacted by risk event

Example Risk Entry – LBNF/DUNE Risk Register Contd.

Explanation of Estimate	Delayed delivery due to production delays, sub-vendor issues or due to unforeseen circumstances.
	Describe how: (1) Probability, (2) Cost impacts, (3) Schedule impacts were estimated
Quality of Risk Estimates	1 - Rough guess

Example Risk Entry – LBNF/DUNE Risk Register Contd.

RISK MITIGATIONS, RISK RESPONSES AND MORE INFORMATION

Cause or Trigger	OPTIONAL: describe event or circumstance that drives this risk.
Risk Mitigations	Continued coordination and communication with BARC-India Describe actions (funded in baseline plan) to reduce risk probability and impact BEFORE risk event occurs.
Risk Responses	Additional coordination with PB installation task to understand how to increase the installation output for magnets, more shifts, more people in single shift or others. Describe actions to be taken to reduce the risk impacts AFTER the risk event occurs
Link to more details	Type the Web address: (Click here to test) http:// Type the description:
Comments	Entered new partner risk related to Magnets

Summary and next steps

- It is important to have a Risk Management Plan to capture and manage project risks – this could be a manual process and spreadsheet based
  - Practicing active risk management will significantly reduce the likelihood of undesired outcomes
- Suggest conducting a joint risk workshop to develop a risk plan and identify the risks to magnet design and production
  - Comment from the PDR: *Risk analyses for both magnet types have been developed at a rudimentary level. These need to be further developed and aligned with Fermilab risk management procedures. The committee would suggest a joint risk workshop with the BARC and FNAL teams to develop a risk plan for the LBNF beamline magnets, consistent with LBNF Project requirements.*

BACKUP
LBNF/DUNE Risk Register and Management

Risk Creation

- **Risk manager determines if an area of the project is lacking in risks**
- **CAM or Project manager is informed that risks are needed**
- **CAM or PM will create new risks in the online risk register with guidance from risk manager**
  - Risks are created as Proposed by default
  - Proposed risks are reviewed every month
- **Risk manager will go through each risk and determine if any areas need improvement**
- **Once risks look acceptable, Risk manager will meet with CAMs, risk owners, and project management to determine if the risk should be opened**
  - A risk's status will be changed from Proposed to Open
  - For a risk to be considered Open, the team must agree on the probability, cost/schedule impacts, and that the risk is realistic
  - Once Open, the risk will be included in the Monte Carlo
  - If a proposed risk is not considered realistic then it is rejected. The proposed risk remains in the register as a record that the team thought about all scenarios

Monthly Risk Management Board

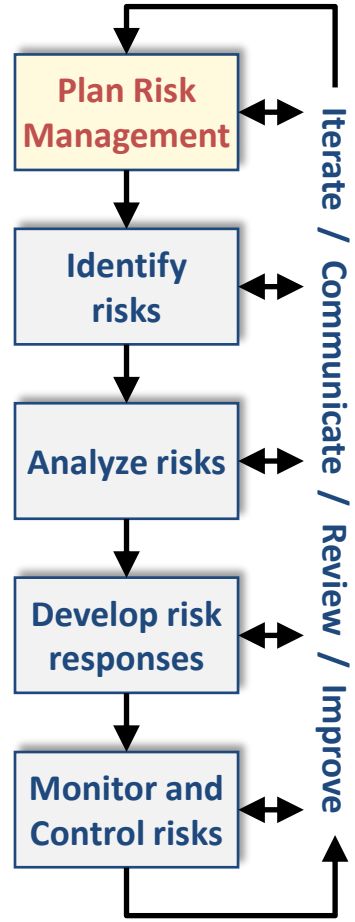
- **Risk board meeting is held once per month**
  - Action items discussed with all risk owners, CAMs, and high-level management
- **Risk triggers per year are reviewed**
  - Able to see how many risks are expected to be triggered in the short-term vs long-term
- **Discuss risks with To-Do items**
  - Risks have notes in a comments field with to-do items
- **Risks greater than 75% probability**
  - Risks that have greater than 75% are reviewed and actions are delegated to update/close/revise these risks
- **All PM Risks reviewed**
  - PM risks affect all subprojects
  - All risk owners present at meeting – able to discuss PM risks effectively
- **All Proposed Risks reviewed**
  - Risks are created proposed by default, then opened after review by risk owners, CAMs, and management
- **Risk areas needing more work are reviewed and updated**
  - If a new subproject or subsystem is created, the new risks are reviewed at this meeting
- Monthly RMB slides can be found here: https://docs.dunescience.org/cgi-bin/private/ShowDocument?docid=2389

Risk Modeling – Monte Carlo

- Risk events are linked to specific schedule activities with associated cost and schedule impacts
- The cost analyses are related only to DOE Scope, and schedule analyses includes DOE and Non-DOE Scope
- The MC analyses include duration estimate uncertainty risk, which is a percentage applied to each task's duration.
- The results are taken at 90% confidence level (C.L.), which is a Fermilab standard
- Opportunities are included in the Monte Carlo
- The data used was extracted from P6 and the risk register after the October update was locked

Roles and Responsibilities

- PM, L2s, Control Account Managers
  - Risk identification, analysis, mitigations and response planning, risk monitoring and control
  - PM chairs the Project Management Board which serves as the Risk Management Board (RMB)
- Fed. Project Director and Lab Mgmt.
  - Advise project, monitor risk process, affirm decisions and contingency use
- Risk Support
  - Coordinational role
  - Maintains risk processes, register, and tools
  - Performs risk modeling and contingency analysis



Fermilab Risk Register

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RISK PROBABILITY AND TECHNICAL IMPACT

Probability	40 %	Estimated risk probability (%). If you have a range enter the mid-point.
Impact - Technical	0 (N) - negligible technical impact	Technical impact AFTER risk mitigation and BEFORE risk responses.

COST IMPACTS

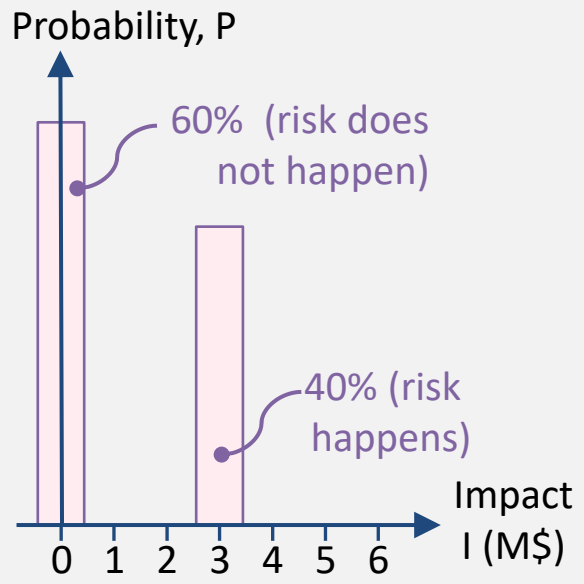
Impact (k$) - Function	1-point - single value	Type of function used to model the cost impact. 1-point - single value --> specify most likely impact only 2-point - flat range --> specify min / max impacts only 3-point - triangular --> specify min / most likely / max impacts
Impact (k$)	3000	Most likely cost impact (k$) of risk event AND associated response plans. Does not include mitigation costs -- these are part of the project baseline. +ve for overruns, -ve for savings
Impact (k$) - Min		Min. cost impact (k$) for 2- / 3-point estimates (not needed for 1-point)
Impact (k$) - Max		Max. cost impact (k$) for 2- / 3-point estimates (not needed for 1-point)

1-point estimate

60 % chance of no overrun

40% chance of an overrun

– Overrun is exactly 3 M$



Fermilab Risk Register

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RISK PROBABILITY AND TECHNICAL IMPACT

Probability	40 %	Estimated risk probability (%). If you have a range enter the mid-point.
Impact - Technical	0 (N) - negligible technical impact	Technical impact AFTER risk mitigation and BEFORE risk responses.

COST IMPACTS

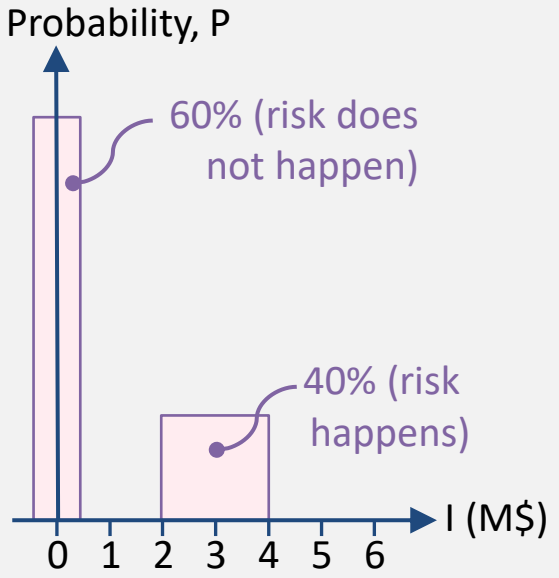
Impact (k$) - Function	2-point - flat range	Type of function used to model the cost impact. 1-point - single value --> specify most likely impact only 2-point - flat range --> specify min / max impacts only 3-point - triangular --> specify min / most likely / max impacts
Impact (k$)		Most likely cost impact (k$) of risk event AND associated response plans. Does not include mitigation costs -- these are part of the project baseline. +ve for overruns, -ve for savings
Impact (k$) - Min	2000	Min. cost impact (k$) for 2- / 3-point estimates (not needed for 1-point)
Impact (k$) - Max	4000	Max. cost impact (k$) for 2- / 3-point estimates (not needed for 1-point)

2-point estimate (range)

60 % chance of no overrun

40% chance of overrun

- Mean overrun is 3 M$
- Overruns from 2–4 M$ are all equally likely



Fermilab Risk Register

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RISK PROBABILITY AND TECHNICAL IMPACT

Probability	40 %

Estimated risk probability (%). If you have a range enter the mid-point.

Impact - Technical	0 (N) - negligible technical impact

Technical impact AFTER risk mitigation and BEFORE risk responses.

COST IMPACTS

Impact (k$) - Function	3-point - triangular

Type of function used to model the cost impact.
1-point - single value --> specify most likely impact only
2-point - flat range --> specify min / max impacts only
3-point - triangular --> specify min / most likely / max impacts

Impact (k$)	3000

Most likely cost impact (k$) of risk event AND associated response plans.
Does not include mitigation costs -- these are part of the project baseline.
+ve for overruns, -ve for savings

Impact (k$) - Min	1000

Min. cost impact (k$) for 2- / 3-point estimates (not needed for 1-point)

Impact (k$) - Max	6000

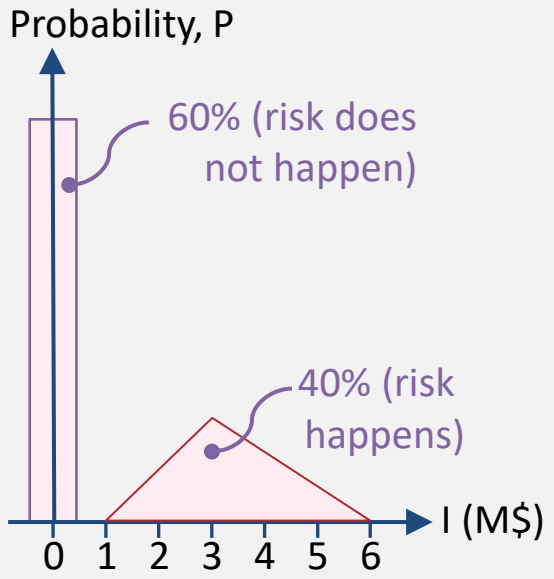
Max. cost impact (k$) for 2- / 3-point estimates (not needed for 1-point)

3-point estimate (triangle)

60 % chance of no overrun

40% chance of overrun

- Most likely overrun is 3 M$
- Overrun as low as 1 M$ but this is unlikely
- Overrun as high as 6 M$ but this is unlikely



Fermilab Risk Register

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RISK PROBABILITY AND TECHNICAL IMPACT

Probability: 40 %
Estimated risk probability (%). If you have a range enter the mid-point.

Impact - Technical: 0 (N) - negligible technical impact
Technical impact AFTER risk mitigation and BEFORE risk responses.

COST IMPACTS

Impact (k$) - Function: 3-point - triangular
Type of function used to model the cost impact.
1-point - single value --> specify most likely impact only
2-point - flat range --> specify min / max impacts only
3-point - triangular --> specify min / most likely / max impacts

Impact (k$): 0
Most likely cost impact (k$) of risk event AND associated response plans.
Does not include mitigation costs -- these are part of the project baseline.
+ve for overruns, -ve for savings

Impact (k$) - Min: 0
Min. cost impact (k$) for 2-

Impact (k$) - Max: 6000
Max. cost impact (k$) for 2-

Schedule impacts are similarly modeled with 1-, 2-, and 3-point probability distributions

3-point estimate (triangle)

60 % chance of no overrun

40% chance of overrun

- Overrun amount is probably small (up to a few M$)
- Small chance of a large overrun (up to 6M$)